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Occurrence of the European ascidian *Ascidiella scabra* (Müller, 1776) in the 19 century in Nagasaki, Japan, probably as an ephemeral alien species

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ABSTRACT The generic affiliation of the single Japanese record of the ascidian genus *Ascidiella*, as "*A. virginea* (Müller)" by Hartmeyer in 1902, was questioned by Nishikawa in 1995 because of the genus's natural distribution being confined to Atlantic waters, the somewhat confused history of taxonomy in the genus and allies, and of the insufficient description. Our personal reexamination of the material collected from Nagasaki and deposited in the Museum für Naturkunde der Humboldt-Universität zu Berlin reveals that it is identical to *Ascidiella scabra* (Müller, 1776), so far recorded exclusively from European boreal to warm-temperate waters. Combining imperfect label information of the material with historical knowledge, the material is supposed to have been collected in February, 1861, by Mr. Otto Schottmüller, a member of the Prussian East Asia Expedition led by Graf zu Eulenburg. It is proposed that the material probably represents an ephemeral population of an alien species.

KEY WORDS *Ascidiella scabra* / ascidian / alien species / ephemeral population / Japan

Introduction

More and more attention has come to be paid to the so-called "alien or invasive species issues" in terms of conservation of biodiversity (see, e.g., Ecological Society of Japan, 2002). When one confronts the issues, the problem is that it is often not easy to decide precisely whether a local population is indigenous or not. This is partly because the biota change through time has been insufficiently documented, and partly because the specific identification tends to become unstable due to subsequent inevitable taxonomic changes (caused, e.g., by discovery of cryptic species). It follows that the actual specimens that have been maintained for many years in museums can play a significant role, though more or less limited according to ways and conditions of preservation, as the "living" evidence to be used for reconstruction of the past biota.

The genus *Ascidiella* in the Japanese ascidian fauna has been represented by a single isolated record of "*Ascidiella virginea* (Müller)" in Hartmeyer (1906, p. 22). His paper is one of the first two monographic works on it, with the other by the first Japanese ascidian taxonomist Prof. Oka Asajiro (see Oka, 1906). The specific name *virginea* is now combined with the generic name *Ascidia*, as clearly distinct from *Ascidiella*, thus used as a valid species name *Ascidia virginea* Müller, 1776. Considering the taxonomic and nomenclatural confusion in the distinction between these two genera and in the specific identification

among their congeners in the past, together with Hartmeyer's insufficient description, Nishikawa (1995) once suggested that Hartmeyer's record might represent the occurrence of a species of the genus *Ascidia*, whose many species occur in Japanese waters (see, e.g., Tokioka, 1963; Nishikawa, 1995). On the other hand, many previous records of *Ascidiella virginea* (Müller, 1776), excepting the Japanese one, were incorporated in those of *Ascidiella aspersa* (Müller, 1776) by Hartmeyer (1924); this species has been collected mainly from European waters, and therefore, is believed to have been introduced to New Zealand since the early 1900s (Cranfield et al., 1998) and to India since 1976 (Nagabhushanam and Krishnamoorthy, 1992). Therefore, another hypothesis is also possible that Hartmeyer's record represents an ephemeral occurrence of *Ascidiella aspersa* in Japanese waters.

To test these hypotheses, Hartmeyer's specimens long kept in the Museum für Naturkunde der Humboldt-Universität zu Berlin was fortunately reexamined. As a result, both of the hypotheses are rejected, although the specimens can still be regarded to represent an ephemeral Japanese population of another alien species.

Historical Background Concerning *Ascidiella scabra* and Allies

The genus *Ascidiella* is unique among ascidians of the family Ascidiidae in having no secondary branchial papillae on the internal longitudinal vessels (see, e.g., Berrill, 1950). After a long history of taxonomic and nomenclatural confusion, the genus is now considered to consist of the three species, *A. aspersa* (Müller, 1776), *A. scabra* (Müller, 1776), and *A. senegalensis* Michaelsen, 1914. Of these, *A. senegalensis*, so far recorded rarely from the Atlantic coasts of northwestern Africa, is peculiar in having the hook-like anterior ends of inner longitudinal vessels (see, e.g., Michaelsen, 1914; Monniot, 1969).

A. aspersa and *A. scabra* were once considered conspecific by some authors including the influential work by Hartmeyer (1924). However, according to a historical review by Berrill (1950), the conspecificity was doubted by some researchers on the basis of differences between them in the body size and shape (especially in the position of atrial siphon), the minimal body size when matured, the size of outer follicle cells of eggs, and in that "in *A. aspersa* the number of longitudinal vessels always outnumbers that of the tentacles, whereas in *A. scabra* the reverse is true" (p. 157). These differences came mainly from a detailed morphological comparison between the two species given by Lindsay and Thompson (1930). The number of longitudinal vessels mentioned is doubtlessly that of the vessels on each side, instead of their total number, because "the longitudinal bars [=vessels] were enumerated in a transverse direction in the right half of the branchial sac" (Lindsay and Thompson, 1930, p. 11). Subsequently, Millar (1966, p. 57) gave a taxonomic key for the identification of Scandinavian ascidians to distinguish one from the other, such as: *A. aspersa* is characterized by the "body length often exceeds 6 cm; tentacles fewer than internal longitudinal bars [=inner longitudinal vessels on each side]", while *A. scabra* by the "body length usually under 4 cm; tentacles more numerous than internal longitudinal

bars". In contrast to *A. aspersa*, *A. scabra* has not yet been recorded from outside European waters, so far as we are aware.

Hartmeyer's (1906) Japanese record of "*Ascidiella virginea* (Müller)", which is the main topic of the present paper, was based on a certain number of specimens collected "von Schottmüller bei Nagasaki", as he detected from old label information, and deposited in the "Berliner Museum" (p. 22). At the same time, Hartmeyer reserved the decisive specific identification of the specimens, taking the possibility of mislabeling into account. Later, Hartmeyer (1924) completely neglected to mention the record from Japan, excluding it from the geographical distribution of *Ascidiella aspersa* (sensu lato, see above), compiled from a thorough survey of the previous records which contained those once referred to as *A. virginea*; however, according to the catalogue of the museum he finally identified the Japanese material as *A. aspersa* (see below). In the present study, the label information for the material is to be considered reliable and correct, rather than false due to mislabeling. Needless to mention, the possibility of mislabeling should always be kept in mind when one treats museum specimens, but it may not be very wise to adopt this possibility primarily.

In this case, Hartmeyer seems to have ruled out such a possibility for the Japanese population to be transported from Europe by human movements, as will be discussed later. In his days, it seems that a species' potentiality of introduction into distant districts by ships was not accepted unanimously, as may be imagined from Visscher's (1938, p. 342) statement "that there is no evidence of distribution of barnacles from one port to another by virtue of the attachment on bottoms of ships".

Materials and Methods

The material examined was labeled "ZMB 1051, *Ascidiella aspersa* (Müller), Nagasaki, Schottmüller", kept in the Museum für Naturkunde der Humboldt-Universität zu Berlin, consisting of 18 individuals; a 44.5 mm long one was dissected with permission. The mentioned label information is quite the same as that seen in the museum's catalogue of "Protochordata", beautifully hand-written (probably by Hartmeyer himself) as "1051, *Ascidiella aspersa* (Müller), Nagasaki, Schottmüller S. [=coll.] / *A. virginea*, Hartmeyer in: Zool. Anz., v. 31, p. 22, 1906 [=Hartmeyer's (1906) paper]". Therefore, it seems certain that the material was ultimately identified as *A. aspersa* by Hartmeyer, as an unpublished taxonomic decision (see above).

We have tried to collect further specimens of *Ascidiella* in Nagasaki Bay, and also to find any old specimens collected there in several museums and institutions in Japan, including the Oka collection of ascidians in the University of Tsukuba as the most probable candidate, but in vain. Moreover, a literature survey of the ascidian fauna around Nagasaki was performed, but we could not detect any positive evidence for the existence of *Ascidiella*, other than Hartmeyer's (1906).

Taxonomic Results

Ascidiella scabra (Müller, 1776)

(Fig. 1)

Limited Synonymy and Previous Records:

Ascidia scabra Müller, 1776, p. 225

Ascidiella scabra: Berrill, 1950, pp. 158–159, fig. 48; Millar, 1952, pp. 23–24; 1959, p. 4; 1966, p. 58, fig. 38; Turon, 1987, pp. 139–140.

Ascidiella aspersa var. *scabra*: Ärnbäck-Christie-Linde, 1934, p. 29, text-figs. 9 and 20, pl. 1, figs. 3–4, pl. 6, figs. 45–46; 1952, pp. 18–19.

Ascidiella virginea: Hartmeyer, 1906, p. 22.

Description: Body length ranging from 29.5 to 44.5 mm; oval or rectangular in outline and flattened laterally. Branchial aperture terminal, with short and wide siphon, while atrial located very close to branchial, and without distinct siphon of tunic (Fig. 1A). Tunic thin (up to 1 mm) and almost transparent; surface almost smooth, devoid of papillae or projections, usually wrinkled faintly, sometimes encrusted only partly with bryozoan colonies and/or some sand grains; bivalves embedded therein (as described by Hartmeyer).

In a 42 mm long already opened and a 44.5 mm long newly dissected specimens, branchial aperture of mantle 8-lobed, while atrial 6-lobed; mantle musculature as a dense network of fibers over whole right side. Branchial tentacles ca. 60, of several sizes; prebranchial zone smooth. Ciliated groove, ca. 1.5 mm long, C-shaped open anteriorly with both horns more or less curled; dorsal ganglion, as long as ciliated groove, located just behind dorsal tubercle (Fig. 1C). Narrow groove, 3.1 mm in a 42 mm long specimen and 4.0 mm in a 44.5 mm one; its anterior terminal found along left posterior half of dorsal tubercle, further extending posteriad beyond dorsal ganglion until dorsal lamina and confluent with it (Fig. 1C). Dorsal lamina tall, ribbed, and smooth-margined. Number of inner longitudinal vessels 31 on left and 36 on right in a 42 mm long specimen, while 33 and 41 in other. No secondary branchial papillae. Main part of visceral mass occupying nearly posterior half of mantle body, with rectum elongated far anteriorly and opening near base of atrial siphon (Fig. 1 B). Stomach very small, located at postero-ventral corner. Axis of first or second intestinal loop nearly longitudinal; that of second loop passing across middle of oesophagus. Anus bi-lobed. Gonad empty.

Remarks: The examined specimens resemble previous descriptions of *A. scabra*, especially those of Berrill (1950) and Millar (1966), in general features such as the position of atrial aperture and the position and arrangement of alimentary tract, and among others, in the number of branchial tentacles in total larger than that of inner longitudinal vessels on each side.

Geographical Distribution: "W. and S. coasts of Norway; W. coast of Sweden; Denmark;

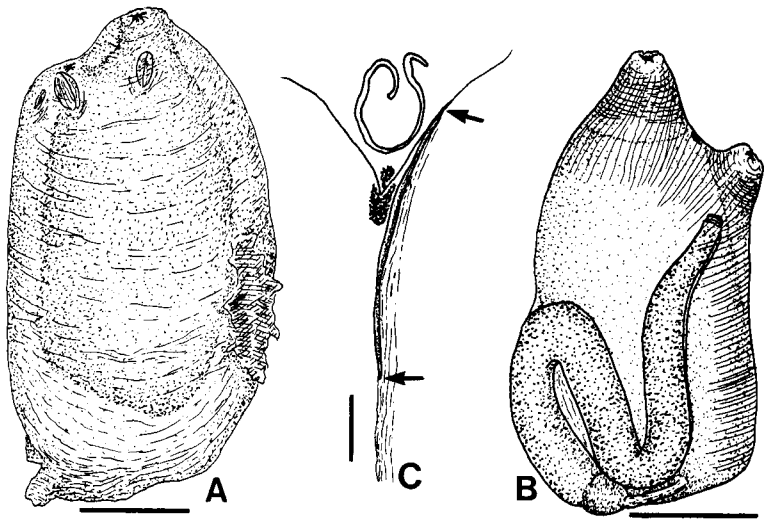

Fig. 1. *Ascidiella scabra* (Müller), 44.5 mm long specimen of ZMB 1051 from Nagasaki, Japan. A, Whole body, right view; B, Mantle body, left view; C, Antero-dorsal part of branchial sac to show ciliated groove, dorsal ganglion, and narrow groove (arrows indicating its anterior and posterior ends). Scales for A and B indicate 10 mm, for C 1 mm.

N[orth] Sea; E. coast of British Isles; Faroe Islands; English Channel; Mediterranean" (Millar, 1966, p. 58); Nagasaki, Japan (Hartmeyer, 1906; present study).

Discussion

When and by whom was the material collected?

The label information tells "Schottmüller" probably as the name of collecter, but without any information about the date of collection. Who is Schottmüller? So far as our historical survey is concerned, the candidate is Mr. Otto Schottmüller. He was a horticulturalist and an assistant of the botanist Dr. Max Ernst Wichura, and stayed in Nagasaki from 17 to 24, February in 1861 as a member of the Prussian East Asia Expedition from 1859 to 1862, led by Graf zu Eulenburg (=Friedrich Albrecht Eulenburg) (see Eulenburg, 1969). Thus, it may be quite natural to suppose that Mr. Otto Schottmüller collected the material of *Ascidiella scabra* from Nagasaki in 1861, and donated it to the "Berliner Museum" before Hartmeyer examined it for his publication in 1906. The successor of the museum, Museum für Naturkunde der Humboldt-Universität zu Berlin has now no available information about "Schottmüller".

A. scabra as an ephemeral alien species in Japan

When the material was collected probably in 1861, the Nagasaki population of *A.*

scabra is supposed to have been more or less flourishing, judging from the large number of individuals in the material. The reason is unknown why the population disappeared completely; we know nothing about what happened in the population between 1861 and the present.

As stated above, *A. scabra* has been so far recorded only from European waters. Then, the disjunct occurrence in Nagasaki, Japan seems most naturally attributable to the introduction of the European population into Nagasaki. This is reinforced by the fact that the geographic distribution of *Ascidiella* is confined to Atlantic waters, so far as indigenous populations are concerned (see above), although Kott (1985; etc.) seems to regard the Australian populations of *A. aspersa* as indigenous. As is known well, the Port of Nagasaki was the single harbor remaining open to any foreign countries (i.e., China and Netherlands) for about 200 years until 1854 when the Tokugawa Shogunate ended the "Sakoku" (closure of country) policy in Japan.

It is true that *A. scabra* is a boreal to warm-temperate species. And the species was probably introduced to Nagasaki by attaching to the outside of ship hulls, instead of internally in the ballast water as may be usually the case nowadays with introduced species; "the regular use of sea water as ballast began in the late 1870s and early 1880s" (Carlton, 1985, p. 316), about 10 years after Schottmüller's collection in 1861. Therefore, one may doubt whether *A. scabra* could reach Nagasaki, living on ship hulls, through tropical waters. However, it may be enough to recall the example that the Japanese oyster *Crassostrea gigas* (Thunberg, 1793) was transported to southern Europe by the early 1800s at the latest and given another name *C. angulata* (Lamarck, 1819), with the dating of transportation coming from Lamarck's publication year of this species; these two has proved synonymous by morphological, ecological, physiological, embryological, and molecular comparisons (see Carlton, 1999). Another example is that the European boreal to warm-temperate bivalves *Mytilus edulis* Linnaeus, 1758 and *M. galloprovincialis* Lamarck, 1819 arrived in the Southern Hemisphere in the early or middle 19 century (see Carlton, 1999), doubtlessly crossing tropical areas.

It is highly probable that the Nagasaki material of *A. scabra* represents an ephemeral population of an introduced species.

Significance of non-type specimens in museums

The real nature of Hartmeyer's (1906) record of "*Ascidiella aspersa*" from Nagasaki could not have been clarified without the material housed for a long time in good condition in the Museum für Naturkunde der Humboldt-Universität zu Berlin. Crucial significance of museum specimens, as well as that of museum activities with relevant systems to curate them appropriately forever, cannot be emphasized too strenuously, whether they are name-bearing types or not.

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